**Mechanics: Momentum and Impulse Worksheet Name:**

**Momentum Questions:**

1. A 21 kg child on a 5.9 kg bike is riding with a velocity of 4.5 m/s to the northwest.
   1. What is the total momentum of the child and bike together?
   2. What is the momentum of the child?
   3. What is the momentum of the bike?
2. What velocity must a 1210 kg car have in order to have the same momentum as a 2250 kg pickup truck traveling at 25 m/s to the east?

**Force and Impulse Questions:**

1. A 0.50 kg football is thrown with a velocity of 15 m/s to the right. A stationary receiver catches the ball and brings it to rest in 0.020 s. What is the force exerted on the ball by the receiver?
2. A 0.40 kg soccer ball approaches a player horizontally with a velocity of 18 m/s to the north. The player strikes the ball and causes it to move in the opposite direction with a velocity of 22 m/s. What impulse was delivered to the ball by the player?
3. A 0.50 kg object is at rest. A 3.00 N force to the right acts on the object during a time interval of 1.50 s.
   1. What is the velocity of the object at the end of this interval?
   2. At the end of this interval, a constant force of 4.00 N to the left is applied for 3.00 s. What is the velocity at the end of 3.00 s?

**Stopping Distance Questions:**

1. A 2240 kg car traveling to the west slows down uniformly from 20.0 m/s to 5.00 m/s. How long does it take the car to decelerate if the force on the car is 8410 N to the east? How far does the car travel during the deceleration?
2. How long would the car in question 6 take to come to a stop from its initial velocity of 20.0 m/s to the west? How far would the car move before stopping?

**Conservation of Momentum Questions:**

1. An 85.0 kg fisherman jumps from a dock into a 135.0 kg rowboat at rest on the west side of the dock. If the velocity of the fisherman is 4.30 m/s to the west as he leaves the dock, what is the final velocity of the fisherman and the boat?
2. A boy on a 2.0 kg skateboard initially at rest tosses an 8.0 kg jug of water in the forward direction. If the jug has a speed of 3.0 m/s relative to the ground and the boy and the skateboard move in the opposite direction at 0.60 m/s, find the boy’s mass.

**Perfectly Inelastic Collisions Questions:**

1. A 1500 kg car traveling at 15.0 m/s to the south collides with a 4500 kg truck that is initially at rest at a stoplight. The car and the truck stick together and move together after the collision. What is the final velocity of the two-vehicle mass?
2. A dry cleaner throws a 22 kg bag of laundry onto a stationary 9.0 kg cart. The cart and laundry bag begin moving at 3.0 m/s to the right. Find the velocity of the laundry bag before the collision.
3. A 47.4 kg student runs down the sidewalk and jumps with a horizontal speed of 4.20 m/s onto a stationary skateboard. The student and the skateboard move down the sidewalk with a speed of 3.95 m/s. Find the following:
   1. The mass of the skateboard.
   2. How fast the student would have to jump to have a final speed of 5.00 m/s.

**Kinetic Energy in Perfectly Inelastic Collisions Questions:**

1. A 0.25 kg arrow with a velocity of 12 m/s to the west strikes and pierces the center of a 6.8 kg target.
   1. What is the final velocity of the combined mass?
   2. What is the decrease in the kinetic energy during the collision?
2. During practice, a student kicks a 0.40 kg soccer ball with a velocity of 8.5 m/s to the south into a 0.15 kg bucket lying on its side. The bucket travels with the ball after the collision.
   1. What is the final velocity of the combined mass?
   2. What is the decrease in the kinetic energy during the collision?

**Elastic Collisions Questions:**

1. A 16.0 kg moving to the left at 12.5 m/s makes an elastic head-on collision with a 14.0 kg raft moving to the right at 16.0 m/s. After the collision, the raft moves to the left at 14.4 m/s. Disregard and effects of the water.
   1. Find the velocity of the canoe after the collision.
   2. Verify your answer by calculating the total kinetic energy before and after the collision.
2. A 25.0 kg bumper car moving to the right at 5.00 m/s overtakes and collides elastically with a 35.0 kg bumper car moving to the right. After the collision, the 25.0 kg bumper car slows to 1.50 m/s to the right, and the 35.0 kg bumper car moves at 4.50 m/s to the right.
   1. Find the velocity of the 35.0 kg bumper car before the collision.
   2. Verify your answer by calculating the total kinetic energy before and after the collision.